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(54) BASE PAINT COMPOSITION FOR TWO-COAT ONE-BAKE COATING

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(71) Applicant : *Aisin Chem Co. Ltd.,*
1141 – 1 Oaza Iinoaza Okawagahara, Fujioka-cho, Nishikamo-gun, Aichi-ken
(72) Inventors : *Toshiaki NUNOMURA*
c/o Aisin Chem Co. Ltd.,
1141 – 1 Oaza Iinoaza Okawagahara, Fujioka-cho, Nishikamo-gun, Aichi-ken
(74) Patent attorney : *Hiroshi OKAWA*

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1. NAME OF THE INVENTION

Base paint composition for two-coat one-bake coating

2. CLAIMS

(1) Base paint composition for two-coat one-bake coating having as distinctive feature that it contains 100 weight parts of acrylic resin
20 ~ 50 weight parts of melamine resin
and 1 ~ 60 weight parts of organic solvent with a boiling point of 180 ~ 250 °C and a surface tension of 30 ~ 50 dyn / cm.

(2) Base paint composition for two-coat one-bake coating of Claim (1), in which the organic solvent is polar solvent

(3) Base paint composition for two-coat one-bake coating of Claim (1), in which 1 ~ 30 weight parts of cellulose acetate butyrate is contained.

3. DETAILED EXPLANATION OF THE INVENTION

[Industrial field of application]

Our invention concerns base paint compositions that are used for two-coat one-bake coatings.

[Prior state of the art]

In the past we have known, for the coating of cars, etc., so-called two-coat one-bake coating methods, which, for example, first coat metallic base paint, coat clear paint with wet – on – wet, and simultaneously bake and dry the metallic base paint and clear paint. With regard to this two-coat one-bake coating, we know that, when we coat the clear paint immediately after the coating of the metallic base paint, the metallic base coat film easily dissolves in the solvent of the clear paint, so they mix in the interface, the orientation of the aluminum flake powder, which is contained in the metallic base paint, is disturbed, and a beautiful metallic feel can no longer be obtained (below this phenomenon is called after tack phenomenon).

In order to avoid this kind of problem in the past, the metallic base paint was left alone for a specified period of time after the coating (flash time), so the solvent disperses and it becomes difficult for the metallic base coat film to dissolve in the solvent of the clear paint, thus preventing the after tack phenomenon.

It is also known to blend cellulose type resin like cellulose acetate butyrate (CAB) in the metallic base paint, thus raising the apparent dryness and making it difficult to dissolve in the solvent of the clear paint.

[Problems our invention intends to solve]

In the two-coat one-bake coating methods mentioned above, the surface tension of the base coat film, of which the solvent has dispersed during the flash time, normally becomes smaller than the surface tension of the clear paint. When we coat the clear paint in this condition, it happens that in the coated clear paint the uniform flow is hampered on top of the base coat film, of which the surface tension has become smaller, and the leveling capacity becomes worse. This bad condition is conspicuous in the thin parts of the clear paint film, with a film thickness of, for example, 10 μm or less, and there have been cases in which the cissing phenomenon occurred in the coat film. In these cases we could also see a deterioration of the water resistance and weather resistance, as a result of the cissing.

Incidentally, all kinds of leveling agents are developed, such as the ones in Tokko 54-34011, Tokko 56-50916, etc., as improvements of the leveling capacity of the paint itself. However, these kinds of leveling agents have as purpose to improve the leveling capacity by lowering the surface tension of the paint itself, and they virtually do not improve the leveling capacity by taking into account the relative surface tension of the mutual paints when doing two-coat one-bake coating.

Our invention takes these facts into consideration, and presents a base paint composition, which can obtain good leveling capacity, even in case the coat film of the clear paint is thin, or the flash time is made longer in two - coat one – bake coating.

[Means to solve the problem]

The base paint composition of our invention has as distinctive feature that it contains 100 weight parts of acrylic resin, 20 ~ 50 weight parts of melamine resin, and 1 ~ 60 weight parts of organic solvent with a boiling point of 180 ~ 250 °C and a surface tension of 30 ~ 50 dyn / cm.

For the acrylic resin we can use the same acrylic resins for baking and coating, which are polymerised from commonly known monomers, as in the past. Normally we use those with a weight average molecular weight of 20000 ~ 50000.

For the melamine resin we can also use the same ones as in the past, and we can use methylated melamine resin or butyrated melamine resin, etc. with a weight average molecular weight of 1000 ~ 5000. It is also okay to use those in which benzo guanamine, urea, etc. was co-condensed together with the melamine.

The blending ratio of acrylic resin and melamine resin is set at 20 ~ 50 weight parts in solid portion of melamine resin against 100 weight parts acrylic resin solid portion. When we are out of this range, bad conditions occur for all sorts of characteristics of the hardened coat film, such as bad hardening, bad water resistance, etc.

The biggest distinctive feature of our inventions lies in the fact that we blend in a specific organic solvent in addition to the resin composition mentioned above. For this organic solvent we use one with a surface tension of 30 ~ 50 dyn / cm. The surface tension of ordinary acrylic baking paint is 20 ~ 30 dyn / cm, so we use one which has a fairly higher value compared to this. When the surface tension of the organic solvent is less than 30 dyn / cm, the improvement of the leveling property when the acrylic paint is coated is insufficient, and when it exceeds 50 dyn / cm, the leveling property of the base paint itself deteriorates.

Also, when the boiling point is lower than 180 °C, the organic solvent ends up dispersing almost entirely during the flash time after the coating of the base paint, so that the effect of increasing the surface tension of the base coat film becomes scarce. When the boiling point is higher than 250 °C, it happens that it remains also on the hardened coat film after the baking, and in some cases the coat film characteristics

deteriorate. As long as the boiling point is in this range, the surface tension of the base coat film goes up, the leveling property of the clear coat film is excellent, and we prevent that it remains on the hardened coat film.

We blend in 1 ~ 60 weight parts of the organic solvent mentioned above against 100 weight parts of acrylic resin solid portion. When the blended in quantity of the organic solvent exceeds 60 weight parts, the amount of solvent that remains on the base coat film even after the flash time becomes too big, and the after tack phenomenon easily occurs at the moment of clear paint coating. When it is less than 1 weight part, no effect becomes apparent. Blending in 5 ~ 20 weight parts is especially preferable.

As the kind of organic solvent mentioned above, we preferably use polar solvents, like carbitol acetate, ethylene glycol, benzyl alcohol, methyl carbitol, diethylene glycol, etc. This is because the surface tension of polar solvents normally shows a high value compared to non – polar solvents. These organic solvents have suitable boiling points and surface tensions as shown in Table 1.

TABLE 1

Organic solvent	Boiling point (°C)	Surface tension (dyn / cm)
carbitol acetate	217.4	31.1
ethylene glycol	197.9	46.5
benzyl alcohol	205.3	39.7
methyl carbitol	194.2	41.3
diethylene glycol	244.3	48.5

In the base paint composition of our invention we can include other resin components like epoxy resin as vehicle. Preferable among those are the ones that contain CAB. CAB has from the past mainly been blended in for the purpose of preventing the after tack phenomenon, but on the other hand, it has the inconvenience that it is inferior in leveling property at the moment of clear paint coating. Consequently, if we blend in CAB in the base paint composition of our invention, we can even further prevent the after tack phenomenon, while at the same time having excellent leveling property. The blending quantity of CAB is normally set at 1 ~ 30 weight parts against 100 weight parts of acrylic resin. When the blending quantity is less than 1 weight part, no effect becomes apparent, and when it is more than 30 weight parts, the viscosity of the paint becomes higher, and a lowering of the dry film thickness occurs along with a lowering of the non-volatile portion at the moment of coating.

There is no particular limitation to other components besides the components mentioned above in the base paint composition of our invention. We can, for example, turn it into a metallic base paint composition by blending in aluminum flake powder. We can also make it solid color by blending in a coloring pigment. And, in the same way as in the past, it also does not matter if we blend in all kinds of additives like ultraviolet ray absorption agent, antioxidation agent, anti-sagging agent, etc.

[Working and efficiency of the invention]

The base paint composition of our invention contains high boiling point organic solvent, with a boiling point of 180 ~ 250 °C and a surface tension of 30 ~ 50 dyn / cm. Therefore, the surface tension of the base paint becomes bigger than the upper coat paint, such as clear paint, which is coated with wet – on – wet on the surface of the base paint.

As a result, in case we coat an upper coat paint with wet – on – wet on top of the base paint composition of our invention, the upper coat paint spreads in thin film shape on

the base coat film surface, it is excellent in leveling property, and we can prevent the cissing phenomenon even in case the film thickness of the clear coat film is thin.

[Examples of implementation]

Below we will explain concretely by means of examples of implementation. The 'parts' below all mean 'weight parts'.

(Example of implementation 1)

<composition of acrylic resin>

We added 80 parts of xylene and 20 parts of n – butanol to a 1 liter flask with 4 openings, and heated it to 100 ~ 105 °C while letting nitrogen gas flow. Next, as is shown in Table 2, we dissolved 2 parts of azo bis isobutyro nitryl (AIBN) in 50 parts of methyl methacrylate (MMA), 40 parts of ethyl acrylate (EA), 8 parts of 2 – hydroxy ethyl methacrylate (2 – HEMA), and 2 parts of acrylic acid, and trickled this solution for two hours in the flask in which the solvent mentioned above was put. After the trickling was finished, we let it polymerise for 6 hours at 100 ~ 105 °C while continuing the stirring, and thus obtained acrylic resin A. The obtained acrylic resin A had viscosity X (Gardner bubble viscosity), a weight average molecular weight of 30000, and a non-volatile portion of 50 weight %.

TABLE 2

	Acrylic resin		
	A	B	C
MMA	50	50	-
2 – HEMA	8		-
2 – HEA	-	10	20
MA	-	-	25
EA	40	-	-
BA	-	40	30
AA	2	2	2
Styrene	-	-	25
AIBN	2	2	4
viscosity	X	W	O ~ P
weight average molecular weight	30000	30000	15000
solid portion	50	50	50

<preparation of base paint composition>

As is shown in Table 3, we blended 40 parts in solid portion of the obtained acrylic resin, 10 parts in solid portion of melamine resin (L – 117 – 60, made by Dainippon Ink Chemical Industries Co.), 10 parts of aluminum paste (MIRAGLON – 1000, made by Toyo Aluminum Co.), 20 parts of an ethyl acetate solution in which CAB (381 – 0.5, made by Eastman Kodak Company) was dissolved 20 weight %, 8 parts of xylene, 7 parts of ethyl acetate, and 5 parts of carbitol acetate as high boiling point organic solvent, stirred well, and further diluted to a viscosity of 15 seconds (Ford Cup No. 4, 20 °C) with a thinner for base, consisting of 50 parts of ethyl acetate, 25 parts of toluene, and 25 parts of Solvesso # 100 (made by Toei Industries Co.), and thus prepared metallic base paint composition (B1) of Example of implementation 1.

<preparation of clear paint>

Using the acryl monomers with the composition shown in Table 2, we composed acrylic resin C for clear paint, letting them polymerise in the same way as mentioned above. We blended 80 parts in solid portion of this acrylic resin C with 20 parts in

solid portion of the same melamine resin as mentioned above, diluted to a viscosity of 25 seconds (Ford Cup No. 4, 20 °C) with a thinner for clear, consisting of 15 parts of toluene, 35 parts of Solvesso # 100 and 50 parts of Solvesso # 150, and thus obtained clear paint.

<coating>

We prepared a soft steel plate, on which an electrode position coat film was formed, an intermediate coat paint was further coated and wet rubbing was done, and coated the metallic base paint composition (B1) mentioned above with air spray, so that the dry film thickness became 15 μ. Then we left it alone for 4 minutes at normal temperature as flash time, after which we coated the clear paint mentioned above on the metallic coat surface so that the dry film thickness became 5 ~ 8 μ. As setting time we left it alone for 7 minutes at normal temperature, then baked for 30 minutes at 140 °C and let it dry.

<test>

With the naked eye we judged the external view of the coat film of the obtained coated plate. We also measured the water resistance, weather resistance and pencil hardness. The results are shown in Table 4.

For the water resistance, we immersed the coated plate for 500 hours in warm water of 60 °C, and judged the external view of the coat film with the naked eye. For the weather resistance, we tested for 3000 hours with a Sunshine Weather meter, after which we judged the external view of the coat film with the naked eye. And for the pencil hardness, we measured the maximum hardness at which no marks were made when we scratched the coat film at an angle of 45 degrees using a Mitsubishi Uni pencil.

(Example of implementation 2)

We prepared metallic base paint composition (B2) in the same way as in Example of implementation 1, except that we used 5 parts of ethylene glycol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 3)

We prepared metallic base paint composition (B3) in the same way as in Example of implementation 1, except that we used 5 parts of benzyl alcohol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 4)

We prepared metallic base paint composition (B4) in the same way as in Example of implementation 1, except that we used 5 parts of methyl carbitol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 5)

We prepared metallic base paint composition (B5) in the same way as in Example of implementation 1, except that we used 5 parts of diethylene glycol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 6)

We prepared metallic base paint composition (B6) in the same way as in Example of implementation 1, except that we used acrylic resin that was composed in the same way as in Example of implementation 1 but using the acryl monomer – B with the composition shown in Table 1. Then we carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are

shown in Table 4.

(Example of implementation 7)

We prepared metallic base paint composition (B7) in the same way as in Example of implementation 6, except that we used 5 parts of ethylene glycol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 8)

We prepared metallic base paint composition (B8) in the same way as in Example of implementation 6, except that we used 5 parts of benzyl alcohol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 9)

We prepared metallic base paint composition (B9) in the same way as in Example of implementation 6, except that we used 5 parts of methyl carbitol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 10)

We prepared metallic base paint composition (B10) in the same way as in Example of implementation 6, except that we used 5 parts of diethylene glycol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 11)

We prepared metallic base paint composition (B11) in the same way as in Example of implementation 1, except that we used 2 parts of methyl carbitol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Example of implementation 12)

We prepared metallic base paint composition (B12) in the same way as in Example of implementation 1, except that we used 24 parts of methyl carbitol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Comparative example 1)

We prepared metallic base paint composition (B13) in the same way as in Example of implementation 1, except that we did not use high boiling point organic solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Comparative example 2)

We prepared metallic base paint composition (B14) in the same way as in Example of implementation 6, except that we did not use high boiling point organic solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Comparative example 3)

We prepared metallic base paint composition (B15) in the same way as in Example of implementation 1, except that we used 51 parts of methyl carbitol as high boiling point solvent, and carried out coating and testing in the same way using the same clear paint as in Example of implementation 1. The results are shown in Table 4.

(Evaluation)

As is clear from Table 4, the coated plates using the metallic base paint compositions of the examples of implementation did not have the cissing phenomenon, which could be seen in the comparative examples, and they were excellent in metallic feel and

leveling property. With the comparative examples on the other hand, cissing occurred and the leveling property was inferior; while there was also the occurrence of bad conditions, namely a deterioration of the water resistance and weather resistance, caused by the cissing. Also, in comparative example 3, in which we blended a large amount of the high boiling point organic solvent, the after tack phenomenon occurred. The bad conditions mentioned above disappeared in the comparative examples as well, in case we coated the clear paint thickly.

In other words, as long as we use the metallic base paint composition of our examples of implementation, we can obtain a coat film that is excellent in leveling property and has no cissing phenomenon, while we can at the same time maintain any kind of coat film characteristic in the same way as in the past, even in case the clear paint is coated thinly. This is clearly because of the effect of blending in a high boiling point organic solvent, which has specific characteristic values.

TABLE 3

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
acrylic resin A	40	←	←	←	←	-	-	-	-	-	40	←	←	-	40
acrylic resin B	-	-	-	-	-	40	←	←	←	←	-	-	-	40	-
melamine resin	10	←	←	←	←	←	←	←	←	←	←	←	←	←	←
aluminum flake powder	10	←	←	←	←	←	←	←	←	←	←	←	←	←	←
CAB 20 % solution	20	←	←	←	←	←	←	←	←	←	←	←	←	←	←
xylene	8	←	←	←	←	←	←	←	←	←	←	←	←	←	←
ethyl acetate	7	←	←	←	←	←	←	←	←	←	←	←	←	←	←
carbitol acetate	5	-	-	-	-	5	-	-	-	-	-	-	-	-	-
ethylene glycol	-	5	-	-	-	-	5	-	-	-	-	-	-	-	-
benzyl alcohol	-	-	5	-	-	-	-	5	-	-	-	-	-	-	-
methyl carbitol	-	-	-	5	-	-	-	-	5	-	2	24	-	-	51
diethylene glycol	-	-	-	-	5	-	-	-	-	5	-	-	-	-	-

TABLE 4

	Examples of implementation												Comparative examples		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Metallic base	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
Base coat film thickness (μ)	15	16	18	19	18	17	17	17	18	19	16	16	18	18	18
Clear coat film thickness (μ)	8	7	8	8	6	5	6	6	5	6	6	5	5	6	5
Coat film external view	O	O	O	O	O	O	O	O	O	O	O	O	X	X	O
Water resistance	O	O	O	O	O	O	O	O	O	O	O	O	X	X	O
Weather resistance	O	O	O	O	O	O	O	O	O	O	O	O	X	X	O
Hardness	H	←	←	←	←	←	←	←	←	←	←	←	←	←	←
After tack phenomenon	no	←	←	←	←	←	←	←	←	←	←	←	←	←	yes

Coat film external view
O ... has no cissing phenomenon
X ... has cissing phenomenon partially or on entire face

Water resistance
O ... has no abnormalities
X ... has whitening and matting

Weather resistance
O ... has no abnormalities
X ... occurrence of cracks